yli130_Assignment 3

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Create & Solve Model

```
# using the library
library(lpSolveAPI)

# set the working directory
setwd("C:/Users/yanxi/OneDrive - Kent State University/Desktop/Quantitative Management Modeling/Assignm

# read the lp file which has the formulation in it
lprec <- read.lp("Weight.lp")

# solve the model
solve(lprec)
```

```
## [1] 0
```

```
# get maximum profit
get.objective(lprec)
```

```
## [1] 696000
```

```
# each decision variable's value
get.variables(lprec)
```

```
## [1] 516.6667 177.7778   0.0000   0.0000 666.6667 166.6667   0.0000   0.0000
## [9] 416.6667
```

Reduced Cost

```
get.sensitivity.obj(lprec) # get reduced cost
```

```
## $objfrom
## [1]  3.60e+02  3.45e+02 -1.00e+30 -1.00e+30  3.45e+02  2.52e+02 -1.00e+30
## [8] -1.00e+30  2.04e+02
##
## $objtill
## [1] 4.60e+02 4.20e+02 3.24e+02 4.60e+02 4.20e+02 3.24e+02 7.80e+02 4.80e+02
## [9] 1.00e+30
```

```
# get range bottom line
get.sensitivity.obj(lprec)$objfrom
```

```
## [1]  3.60e+02  3.45e+02 -1.00e+30 -1.00e+30  3.45e+02  2.52e+02 -1.00e+30
## [8] -1.00e+30  2.04e+02
```

```
# get range upper line
get.sensitivity.obj(lprec)$objtill
```

```
## [1] 4.60e+02 4.20e+02 3.24e+02 4.60e+02 4.20e+02 3.24e+02 7.80e+02 4.80e+02
## [9] 1.00e+30
```

Reduced cost value is shown in the next shadow price dual part.

Shadow Price

```
get.sensitivity.rhs(lprec)  # get shadow price / dual solution
```

```
## $duals
##  [1]    0.00    0.00    0.00   12.00   20.00   60.00    0.00    0.00    0.00
## [10]   -0.08    0.56    0.00    0.00  -24.00  -40.00    0.00    0.00 -360.00
## [19] -120.00    0.00
##
## $dualsfrom
##  [1] -1.000000e+30 -1.000000e+30 -1.000000e+30  1.122222e+04  1.150000e+04
##  [6]  4.800000e+03 -1.000000e+30 -1.000000e+30 -1.000000e+30 -2.500000e+04
## [11] -1.250000e+04 -1.000000e+30 -1.000000e+30 -2.222222e+02 -1.000000e+02
## [16] -1.000000e+30 -1.000000e+30 -2.000000e+01 -4.444444e+01 -1.000000e+30
##
## $dualstill
##  [1] 1.000000e+30 1.000000e+30 1.000000e+30 1.388889e+04 1.250000e+04
##  [6] 5.181818e+03 1.000000e+30 1.000000e+30 1.000000e+30 2.500000e+04
## [11] 1.250000e+04 1.000000e+30 1.000000e+30 1.111111e+02 1.000000e+02
## [16] 1.000000e+30 1.000000e+30 2.500000e+01 6.666667e+01 1.000000e+30
```

```
# get shadow price value (the first 11 value)
get.sensitivity.rhs(lprec)$duals
```

```
##  [1]    0.00    0.00    0.00   12.00   20.00   60.00    0.00    0.00    0.00
## [10]   -0.08    0.56    0.00    0.00  -24.00  -40.00    0.00    0.00 -360.00
## [19] -120.00    0.00
```

```
# get range bottom line
get.sensitivity.rhs(lprec)$dualsfrom
```

```
##  [1] -1.000000e+30 -1.000000e+30 -1.000000e+30  1.122222e+04  1.150000e+04
##  [6]  4.800000e+03 -1.000000e+30 -1.000000e+30 -1.000000e+30 -2.500000e+04
## [11] -1.250000e+04 -1.000000e+30 -1.000000e+30 -2.222222e+02 -1.000000e+02
## [16] -1.000000e+30 -1.000000e+30 -2.000000e+01 -4.444444e+01 -1.000000e+30
```

```
# get range upper line
get.sensitivity.rhs(lprec)$dualstill
```

```
##  [1] 1.000000e+30 1.000000e+30 1.000000e+30 1.388889e+04 1.250000e+04
##  [6] 5.181818e+03 1.000000e+30 1.000000e+30 1.000000e+30 2.500000e+04
## [11] 1.250000e+04 1.000000e+30 1.000000e+30 1.111111e+02 1.000000e+02
## [16] 1.000000e+30 1.000000e+30 2.500000e+01 6.666667e+01 1.000000e+30
```

As shown above, dual value is 0, 0, 0, 12, 20, 60, 0, 0, 0, -0.08, 0.56, 0, 0, -24, -40, 0, 0, -360, -120, 0. Dual value is mixed with shadow price and reduced cost.

The first 11 is shadow price value which is 0, 0, 0, 12, 20, 60, 0, 0, 0, -0.08, 0.56.

THe last 9 is reduce price value which is 0, 0, -24, -40, 0, 0, -360, -120, 0.

Range of Reduced Cost

Here I am trying to build a data-frame which can show the results clearly.

```
# build 3 columns
Plant_Size <- c("Plant1_Large", "Plant1_Medium", "Plant1_Small", "Plant2_Large",
                              "Plant2_Medium", "Plant2_Small", "Plant_3_Large",
                                                  "Plant3_Medium", "Plant3_Small")

Reduce_Cost_Bottom <- c(3.60e+02, 3.45e+02, -1.00e+30, -1.00e+30,
                                       3.45e+02, 2.52e+02, -1.00e+30, -1.00e+30, 2.04e+02)

Reduce_Cost_Upper <- c(4.60e+02, 4.20e+02, 3.24e+02, 4.60e+02, 4.20e+02,
                                                 3.24e+02, 7.80e+02, 4.80e+02, 1.00e+30)

# build data-frame
Reduce_Cost_Range <- data.frame(Plant_Size, Reduce_Cost_Bottom, Reduce_Cost_Upper)

# show Reduced Cost Range results
Reduce_Cost_Range
```

```
##      Plant_Size Reduce_Cost_Bottom Reduce_Cost_Upper
## 1  Plant1_Large           3.60e+02          4.60e+02
## 2 Plant1_Medium           3.45e+02          4.20e+02
## 3  Plant1_Small          -1.00e+30          3.24e+02
## 4  Plant2_Large          -1.00e+30          4.60e+02
## 5 Plant2_Medium           3.45e+02          4.20e+02
## 6  Plant2_Small           2.52e+02          3.24e+02
## 7 Plant_3_Large          -1.00e+30          7.80e+02
## 8 Plant3_Medium          -1.00e+30          4.80e+02
## 9  Plant3_Small           2.04e+02          1.00e+30
```

Range of Shadow Price

Similar as the Reduced Cost shows above.

```r
# build 3 columns
Constraints <- c("Constraint_1", "Constraint_2", "Constraint_3", "Constraint_4", "Constraint_5",
                                 "Constraint_6", "Constraint_7", "Constraint_8", "Constraint_9",
                                                                  "Constraint_10", "Constraint_11")

Shadow_Price_Bottom <- c(-1e+30, -1e+30, -1e+30, 1.122222e+04, 1.15e+04, 4.8e+03, -1e+30,
                                                        -1e+30, -1e+30, -2.5e+04, -1.25e+04)

Shadow_Price_Upper <- c(1e+30, 1e+30, 1e+30, 1.388889e+04, 1.25e+04, 5.181818e+03, 1e+30,
                                                                1e+30, 1e+30, 2.5e+04, 1.25e+04)
# build data-frame
Shadow_Price_Range <- data.frame(Constraints, Shadow_Price_Bottom, Shadow_Price_Upper)

# show Shadow Price Range results
Shadow_Price_Range
```

```
##      Constraints Shadow_Price_Bottom Shadow_Price_Upper
## 1   Constraint_1       -1.000000e+30       1.000000e+30
## 2   Constraint_2       -1.000000e+30       1.000000e+30
## 3   Constraint_3       -1.000000e+30       1.000000e+30
## 4   Constraint_4        1.122222e+04       1.388889e+04
## 5   Constraint_5        1.150000e+04       1.250000e+04
## 6   Constraint_6        4.800000e+03       5.181818e+03
## 7   Constraint_7       -1.000000e+30       1.000000e+30
## 8   Constraint_8       -1.000000e+30       1.000000e+30
## 9   Constraint_9       -1.000000e+30       1.000000e+30
## 10 Constraint_10       -2.500000e+04       2.500000e+04
## 11 Constraint_11       -1.250000e+04       1.250000e+04
```

Formualte Dual and Solve

```r
# formulate the duals in the lp file
lprec_new <- read.lp("Assign3.lp")

# solve the dual model
solve(lprec_new)
```

```
## [1] 0
```

```r
# get dual optimal solution
get.objective(lprec_new)
```

```
## [1] 696000
```

```r
# get dual decision variables
get.variables(lprec_new)
```

```
##  [1]  0.00  0.00  0.00 12.00 20.00 60.00  0.00  0.00  0.00 -0.08  0.56
```

According to the above result, dual model optimal solution is the same as primal model, and dual model's decision variables' value is exactly the primal model's shadow price value.